TRUST IN INTERFIRM ALLIANCES: THE CASE TECHMED-NIPPONTECH

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Introduction

The concept of trust has been the subject of many studies in social sciences such as psychology or sociology. If economics has recognized the importance of trust in economic relations by the beginning of the 1970's, it is only recently that it has been accepted in management, via organization theory (Butler, 1991; Hosmer, 1995)

Partnerships and alliances constitute a privileged field for the study of trust because it contributes to the existence of such exchanges, to the understanding of their dynamics and to explain their performances and success (Guibert, 1999). Trust allows cooperative behaviour (Gambetta, 1988), increases organizational learning during the co-operation (Ingham, Mothe 1998) and modifies rules and routines shared by the partner firms (Lazaric and Lorenz, 1998).

This article aims mere particularly to identify the process of production and development of trust in a bilateral partnership in Research and Development (R&D). Our main objective is to explore and understand the dynamics of trust during the life cycle of this co-operation in order to progressively develop an "interpretative framework".
Following suggestions for research from case studies (Yin, 1984; Eisenhardt, 1989)), we developed our understanding of trust by adopting neither a pre-established approach nor a given definition right from the beginning.

In the first part, we will make a brief review of the literature on trust in inter-firm partnerships. Our main objective is to build the basis for introducing the research and not to discuss concepts in detail. Emphasis is on articles which offer keys and insights to begin our case study, namely those that are interested in -the dynamics of agreements, - the various trust types according to the stage of the cooperation, - the causal role played by trust in the success of the cooperation
The second, and central part is dedicated to the exploratory study on the way trust was built up, and then evolved during the R&D cooperation between TECHMED and NIPPONTECH in the field of proton-therapy. Emphasis is on the dynamics of intra-organizational and inter-organizational trust at two levels: individual (inter personal) and collective (in and between teams).

I – TRUST IN INTERFIRM ALLIANCES

Literature on trust in inter-firm partnerships is rich but fragmented and debated. Nevertheless some common subject, can be, identified[1] – (1) the "level" of analysis (individual, collective, institutional), "intra and/or inter-organizational" trust, (2) issues of coordination, vulnerabilities (opposite selection, moral hazard, hold-up, etc)-uncertainty and risks - (3) types, characteristics origins of measures of trust (4)-the dynamics of trust during the collaborative life cycle.

(1) Several authors have established a distinction, which seems fundamental to us, between trust accorded to individuals (Granovetter, 1985), and an impersonal or procedural trust, accorded to institutions (Shapiro, 1987). Trust can also be shared among individuals who are members of organizational "groups". This can lead to a "collective" trust. If little agreement exists on

the concept of trust, its dimensions and the fundamental elements of its definition are comparable in studies on intra-organizational and inter-organizational contexts and in various disciplines. Theoretical background on trust allowed developing empirical analysis, which often take the point of view of one partner. This perspective has of course the effect of slanting analysis to some extent (as far as the authors often make the implicit hypothesis that B trusts A if A says that he trusts B).

(2) The analysis of trust at the inter-organizational level is particularly interesting when trust is seen as an alternative to control and coordination. Baudry (1995) and economists tend today to distinguish three forms of inter-firm coordination: market rules, organizational authority and cooperation based on trust. Appeal to this last concept is justified by the presence of risks (see (3) hereunder), all the more apparent as the duration and complexity of the exchange relation are big (Billette, 1999). Trust has also been presented as a partial substitute to formal contracts. Contracts contribute to reduce uncertainty and risks. Most alliances are based on formal contracts but due to the very nature of R&D, especially in high technology-based R&D, these contracts are often highly incomplete. Co-development contracts also require mutual trust where the standards of behaviour and the actors' capacities play a central role (Bidault, 1998). Barney and Hansen (1994) suppose that there is more trust when parties do not establish a joint venture. Other authors have studied actions taken by firms in the absence of any contract. To trust implies to agree to be vulnerable in conditions of risk, uncertainty and interdependence. . Rousseau et al. (1998) define trust as a: " psychological state including the intent to accept the vulnerability based on positive expectations of intentions or of mutual behaviour ". The variations of risk, uncertainty and interdependency can alter the level as well as the form of trust in alliances. Degrees of interdependence can influence the form assumed by trust, which depends on the context of the relation. At one extreme, some authors consider trust as being part of a moral order in which reciprocity is based on goodwill or on ethical or moral principles. Trust then looks like a "tautology" (Koenig 1999) because there is no more uncertainty as to the behaviour of the other party. At the other extreme trust is completely treated in terms of the counterpart of transaction costs or as the sub-element of risk (Williamson, 1993). But, as stressed by Ring and Van De Ven (1992), high levels of risk and trust may coexist in cases where organizations use relational contracts as in common R&D.

(3) The characteristics as well as the origins of trust are numerous: (for example, for Hosmer, 1995, integrity, loyalty, competence, openness and continuity. They are, to a large extent, perceived attributes of the other party. These characteristics can be, in certain cases, sources for a measure, direct or indirect, of trust. It is possible to find approached variables (proxy) of the presence or absence of trust by analysing the expectations of parties in contracts. Measures used by authors, in particular in quantitative research, are essentially drawn from the psychology and sociology literature with a strong ascendancy of the interpersonal aspect (cf. Gulati, 1995; Zaheer, McEvily and Perrone, 1998. A distinction has also been made between "calculated", "institutional", and "relational" trust. Origins of trust are also various; competence-contract-goodwill, (Sako, 1991), familiarity, previous relationships and repeated ties (Gulati 1995), reputation and reputation effects, etc… would influence the building and development of trust. The various types of trust and their dynamic evolution during cooperation are the objects of different approaches. Authors, such as Koenig (1999), estimate that trust evolves from an inter-individual willingness to a system of inter-institutional anticipations. For others, the relation begins thanks to the signals, which are based on an

institutional trust (Mangematin, 1999. We assume that the evolution in trust depends on the context of each situation.

(4) Literature on trust is still rather poor in terms of process analysis. The concept of «reliance on trust», (Ring and Van de Ven, (1994), which is the fact of being able to count on trust, pleads in favour of this kind of approach. Process analysis is developing in literature devoted to the dynamics of cooperation and to the emergence of network organizations, where trust plays a key role (Lazerson, 1988; Larson, 1992; Lazerson, 1995; Lorenzoni and Baden-Fuller, 1995; Doz, 1996; Ring, 1996, 1997; Osborn and Hagedoorn, 1997).

This brief background and previous research we led separately raised a set of questions that puzzled us and increased our motivation to develop our investigations on the dynamics of trust in R&D partnerships. The objectives of the first was to analyse organizational learning processes in R&D alliances led by TECHMED (Ingham 1995) The second aimed at analysing the determinants of result appropriation in R&D consortia in the framework of the European Eureka program (Mothe 1999). In both works trust was not the focus of the research but appeared to have an influence on learning and, indirectly on result appropriation (through learning) (Ingham, Mothe 1998)[2]

The questions are the following: what could be the interplay between individual and "collective" learning at the organizational and inter-organizational levels?

II – TRUST IN THE TECHMED NIPPONTECH COOPERATION

1. Specificity of the TECHMED – NIPPONTECH case study

Even in this instance, the TECHMED-NIPPONTECH case supplies an illustration which, without claiming to have any external validity (due to its uniqueness), can establish a starting point for the search for an answer to this question of trust.

It seems to us that R&D cooperation supply a particularly interesting ground for the study of trust for the following reasons:

-The characteristics of these alliances, bound to the specificity of R&D: strong uncertainty as to produced results

-The extreme difficulties resulting in a contract to avoid any form of opportunism, risks increased by undesired appropriation of competence by the partners

1. Presentation of the partners and of the proton-therapy agreement

Founded in 1986, TECHMED produces a range of cyclotrons for applications and groups of specific customers. TECHMED is considered today as one of the world leaders in its industry. This position was obtained through internal development and, more recently, through acquisitions. Certain systems were also developed in cooperation. Such is the case in proton-therapy. There has been considerable interest in cyclotrons for the treatment of cancer. Several techniques are in competition: electrons, photons, neutrons and protons (the most recent). While

rather expensive, the latter has the advantages of not damaging the tissues situated on the passage of the ray and of having a maximized impact on the tumour. This therapy works well for the treatment o f certain pathologies.

TECHMED developed a new cyclotron dedicated to proton-therapy with a small and highly specialized unit of NIPPONTECH, a big Japanese company. Cooperation was initiated in 1992 after one year of negotiations. Initial agreement covered R&D, production and marketing of the system. At the R&D level, each partner develops parts or sub-systems of the new cyclotron. All the necessary information to develop interfaces is put at the disposal of the partner, as well as any data on proton-therapy. Investments and costs would be shared 50-50 until the realization of the design. A prototype will be developed after the reception of the first order. Marketing, as well as after-sales service, would be done according to a geographical split (Asia: NIPPONTECH, Europe and North America: TECHMED). Each partner, in cooperation with the other, would assemble the systems sold in its geographic area.

The development of this complex system lasted about three years: concept and design of the cyclotron, peripheral elements of the system and applications in proton-therapy. The first stages of the concept were achieved according to the indications of the agreement. The system was conceived to satisfy specifications that were at the forefront of technology standards established by a North American advanced university hospital. The product was developed after the project had been selected further to an international and highly competitive call for tenders. A second order was obtained from a similar establishment in Japan. In 1999, a big Hospital chain in North America ordered a third system. It signed an exclusive agreement for the construction of proton-therapy centres with TECHMED.

Let us note that the installation of such systems lasts several years, length connected to the complexity, to the novelty of the technology and to the necessity of acceptance by both Japanese and North American Authorities. In August 1999, the system installed in Japan had already been able to treat about twenty patients.

3. Methodology of the case study and collection of data

The methodology applied here is inspired by principles expressed by Yin (1984) for case study research. Rather than applying a purely inductive or deductive methodology, our process of search is iterative. We tried to identify certain empirical "regularities", to gradually develop a conceptual scheme, which would help to interpret and "explain" our case study, or which at least enables to suggests some “explanations”.

Data were collected during two “waves” of interviews, completed by some internal documents and external information from the press and the companies’ Internet sites. We also benefited from informal contacts during our stay at TECHMED (discussions during lunch, …). Two periods of immersion at TECHMED, lasting on an average three months each, took place between 1992 and 1994.

More than 30 semi-structured face-to-face interviews with about twenty persons, of about two hours, were conducted during the second phase of this first period, after the long and numerous

open and non-structured interviews of the first phase. Sometimes, we initiated group discussions to understand stakes at a collective level (for example, the group of mathematicians, designers, etc.). All interviews (32) were recorded and rewritten extensively. Their analysis and interpretation were completed as soon as possible and were used as a basis for the next stage of interviews.

The second period of field research (collection of data and interpretation) took place in 1999, period during which most interviews at NIPPONTECH were carried out. We are aware of the possible bias of *a posteriori* rationalization linked to these interviews in 1999 in Japan, relative to the alliance since its origin.
We tried to limit this bias by collecting multiple data. The objective of this period was to get additional information and to update data by insisting on aspects connected to trust, and by collecting data from TECHMED's partner to confront certain points of view. Interviews were made of key actors of NIPPONTECH, and some exchanges of electronic mail took place with members of TECHMED.

These waves of interviews and of data collection correspond to two periods of intense activity in the alliance: developments of the concept between 1992 and 1994, and installation, tests and first treatments of patients between 1998 and 1999. Between these two periods, we continued to follow the project informally through contacts with TECHMED's members and reading communiqués and press articles. This period was essentially characterized by intense efforts in marketing, rewarded at the end of 1997 by a first order.

Appendix 1 presents the main stages in the relations among TECHMED and NIPPONTECH, before and during the life cycle of the agreement to the date of the formal agreement, the main activities concluded, the initiators as well as the actors (or groups of actors) involved in the relations.

4. Evolution of trust in the TECHMED – NIPPONTECH cooperation

The evolution of trust between TECHMED - NIPPONTECH can be analysed by distinguishing the various aspects presented in the first part of this article. We shall privilege a chronological approach according to the various stages appearing in **appendix 1**. At each stage, we identify the origins of trust (and, sometimes, of a certain distrust), the context in which relations are established, the levels of analysis (individual / group, inter-organizational / intra-organizational). This allows us to understand the complex nature of the phenomena studied here. Besides, rather than supplying an interpretation to the reader systematically, we have chosen to present (*in italics*) interview extracts in order to remain as close to the case as possible. **Appendix 2** presents the various actors of both companies and their respective function in the project.

4.1. Relations prior to the proton-therapy agreement (1988-1989)

Relations between TECHMED and NIPPONTECH developed before the negotiation of the agreement in proton-therapy. TECHMED, recently created, was in search of partners to develop its activities. Contacts were made in 1988 with various designers and manufacturers of cyclotrons, one of whom was NIPPONTECH:

" TECHMED looked for financial means to develop new machines. JO spoke to us about it, I tried to help them but a lot of people here did not know TECHMED, which was such a small firm at this time… And the decision processes are sometimes long in a company such as ours " (Sa, NIPPONTECH, 1999)

" We visited NIPPONTECH. I knew the persons in charge of the development of cyclotrons, which belong to a small division, and asked them if they would not be interested to participate in the development of TECHMED. For internal reasons to NIPPONTECH, they did not follow us, in spite of the efforts of Sa and of his director " (JO, TECHMED, 1995)

4.1.1. The origins of trust

The origins of trust between members of TECHMED and NIPPONTECH in 1989 are varied. They cover essentially three domains: competence, behavior and understanding of cultures. The first two aspects join two of the three trust types individualized by Sako (1991) - the third being contractual trust. We believe that the understanding of cultures is highly similar to the institutional level, identified as a key factor in the study of trust, rooted culturally (Sako, 1988).

The origins of trust among the partners can be looked after, from NIPPONTECH's point of view (cf. **appendix 2** for the names and roles of quoted actors) in:
- JO's reputation, founder of TECHMED, within the scientific and technical community,
- The fact that JO is opened to the Japanese culture, sharing close values,
- The help brought to Sa and his team by JO and his colleagues in technical domains which were not a part of the agreement,
- The active commitment of TECHMED's team in the realization of the contract.

From TECHMED's point of view, the origins of trust hold essentially:
- In JO's perception of the technical competence of Sa and his team,
- In the interest in Japan and in its culture.

1. Knowledge and perceived competencies

A priori trust in the scientific and technical competence is at the origin of the contact taken by NIPPONTECH with TECHMED:

" I met JO on the occasion of a contract for the JAERI. We were in search of an ion source. At this time, Ta knew about noises according to which JO had developed a new source. They knew each other and JO enjoyed a foreground reputation in the scientific community " (Sa, NIPPONTECH, 1999)

" JO is one of the best specialists in the world in the development of cyclotrons " (Shi, NIPPONTECH, 1993).

" I had met Ta, one of their scientists, in congresses, as well as Sa. We made our classes on the same types of cyclotrons. Therefore, we spoke about the same technical language, we understood each other and I was quickly put in confidence" (JO, TECHMED, 1994)

The role played by Ta and JO in the perception of their team members illustrates the passage of an individual trust into a collective *a priori* trust, even before a contact really took place between the teams:

" Ta, whom we consider as a brilliant person here and who is our intellectual guide on the scientific side, knew JO. He spoke to us about the rumour concerning JO's discovery of a source that could be interesting for us and informed us of his opinion concerning JO. Ta is a remarkable person. He developed the first accelerators. (...) Ta knows JO and trusts him; as I have myself a big trust in Ta, I informed my team about the project " (Sa, NIPPONTECH, 1999)

" JO knew them and relied on them. We had really no idea on this subject, we followed him " (DU, TECHMED, 1994)

" We are a few in the world to develop cyclotrons. We form a small scientific community, we know all well and maintain friendly relations even though we are competitors. Ta is one of the pioneers of cyclotrons in Japan. We were only a few here at that time and I had no difficulty convincing my colleagues to work with them because I knew they were serious scientifically and technically" (JO, TECHMED, 1994)

Trust increased from the very first contacts between the two small teams, in Japan and in Europe. The first meeting resulted very quickly in the beginning of contract negotiations:

" We were happy to work with them. We did not know them, except for JO, but DU and BO made a fantastic work. They are really very strong in the field of sources. They at once put us in confidence " (Sa, NIPPONTECH, on 1999)

" What is essential is to work together. In this way, one can appreciate the real competence of the others, by trying to solve problems and by discussing to find solutions. It very well worked with NIPPONTECH's team, we learned to know each other and trust each other more and more» (DU, TECHMED, 1994)

Therefore, deals are, for the greater part, established on the basis of pre-existing relationships, whether personal or organizational. If Koenig (1999) wonders about the way trust can appear in an initial context where there is no previous familiarity among partners, the question of genesis does not seem fundamental to us as far as companies rarely begin a commercial relation "from scratch ", without preliminary knowledge of the partner. In cases where no personal relationship exists between members of the two organizations, these enter in contact in a certain context: they possess references, a reputation, and an accreditation.

TECHMED and NIPPONTECH, and in particular their leaders, are drawn into a network that is sufficiently restricted so that the firms convey a reputation as to their know-how and technical expertise. As such, there is no absence of familiarity. In our case, their leaders knew the others at first by reputation and soon met in congresses, colloquiums, but also as they were looking for capital (TECHMED at NIPPONTECH), and, finally they came to appreciate each other.

2. Behaviour

The second source of trust can be found in the behaviour adopted by the two parties during negotiations and at the time of the final signing of the contract. This can be illustrated by the "open" attitude and dialogue between partners, by the mutually strong commitment, by a concern to help the partner in domains not covered by the agreement and, more fundamentally, in personality features and styles of management. Again, we can identify some dimensions that characterize this type of trust when we examine the preliminary contract - even though it is at NIPPONTECH that one insists on these aspects, TECHMED being here the supplier of NIPPONTECH. Indeed, human values perceived by the partner play an essential role (goodwill):

We were happy to work with JO and his team, not only because they are of a very high level but also because we soon found that he possessed human qualities, creativity, friendship, honesty and a highly humanist sense. We found this was also true for his co-workers and it helped a lot to develop and strengthen our contacts. I think that we share the same sense of human values " (Shi, NIPPONTECH, 1993)

" You know, I established real friendly relations with the chiefs of the cyclotron team in Japan, a certain way of conceiving things of life " (JO, TECHMED, 1993)

3. Mutual understanding of cultures

A third source of trust holds in the perception that the partners have of the understanding of their own culture by their partner. Again, especially NIPPONTECH's members consider this as central:

" An important point is that each tries to understand nationalities and cultures. I worked in French-speaking Europe and understand well enough and appreciate French culture. I fast discovered that JO and his team appreciated Japan. We love informal contacts, go to drink together after meetings. JO came with us and accompanied us sometimes late. It creates bonds of friendship and mutual understanding (Sa, NIPPONTECH, 1999)

" I have a very good contact with Japanese, I appreciate a lot many aspects of their culture and like to work with them» (JO, TECHMED, 1994)

4.1.2. The negotiation and realisation of the preliminary contract

The negotiation of the contract was rapid. This is due to the fact that the team managers in charge of negotiations at NIPPONTECH (Ta, Sa) and at TECHMED (JO, MO) shared the same wishes, attitudes, behaviour and type of management. For NIPPONTECH, it is linked to the personality of Ta but also to the fact that the contract was not very important, financially speaking, and that the implied team was of small (arguments which correspond to characteristics leading to trust expressed by Gill and Butler, 1996):

" Negotiation was roundly led and required only few contacts. We were at once put in confidence by their opening and by the fact that they went to the main thing. You know, it is not so current that one works openly " (JO, TECHMED, 1994)

" Sa showed himself very open, supplied us with all the necessary information, including what it would cost them to develop such a source; we worked hand in hand, with cost structures as a support. This is a first-rate proof of trust" (MO, TECHMED, 1993)

" JO and MO came here, met our customers to make an idea of the work to carry out and rapidly proposed a price. They explained to us what it would cost them in development and in adaptation. We did not discuss and accepted this price by relying totally on them. (...) The manager of our unity makes fast decisions, which is not always the case in as big a company as ours. In this contract, we had a big autonomy. At TECHMED also, they make decisions fast, it allowed us to conclude after a few meetings " (Sa, NIPPONTECH, 1999)

It is the attitude of TECHMED's members during the realization of the contract, but also outside the contract, which seems to have the most widely contributed in establishing and in strengthening a climate of trust among individuals and teams. Along with competence, it is the willingness, the goodwill of TECHMED's members and their way of working that is perceived as determinant at NIPPONTECH:

" They make all they can, do not count their hours, work like us, often during the weekend and late in the evening. They form an entrepreneurial small team, as we do within our big company " (Sa, NIPPONTECH, 1999)

" When we met, we discussed of course the project but also the problems we encountered in the development of some equipment. JO and DU gave us ideas. To help each other is important. Our teams began to discuss these with them and we sometimes sent them faxes to ask them if they had not met such or such problem in some of their developments. We sometimes helped them also, I hope " (Shi, NIPPONTECH, 1994)

" Sa and I worked on the same type of machine. I sometimes helped him in an informal way to solve small problems he met in the development of his prototypes. This is rather natural. It is true as well that I spent quite a lot of hours to discuss with him and to exchange ideas on technologies which did not have anything to do with ion sources " (JO, TECHMED, 1994)

4.2. The cooperation en proton-therapy

4.2.1. Context and negotiation of the proton-therapy agreement (1991-1992)
Cooperation in proton-therapy was initiated by TECHMED.

To identify the dynamics of trust we insist upon the phases during which interactions among partners were the most marked (cf. **appendix 1**):
- Negotiation of the contract (1991-1992),
- -Development of the concept, in particular the cyclotron that is the central equipment (1992-1995),

- Installation and test of the system in Japan (1998-1999).
-

In 1991 TECHMED attempted to exploit a new technology for the treatment of certain cancers. Several technologies were in competition and proton-therapy was promising - although expensive and risky. The NIPPONTECH team had also intended to break into this activity:

" I had the idea to launch a proton-therapy project. We had a colleague (LA) who had original ideas for the development of an advanced proton cyclotron. We went to find NIPPONTECH because we looked for a solid partner who could open markets in Asia. Our previous cooperation had worked well and we thought they could be interested to work with us on this project " (JO, TECHMED, 1994)

" At that moment, we tried to develop an equipment for proton-therapy. We were surprised learning that TECHMED was also interested in it. When JO contacted us, we had both begun independent processes in proton-therapy. Finally, we have, after a relatively long negotiation, decided to join our efforts and to work together» (Sa, NIPPONTECH, 1994)

The experience of working in common in 1989 and the trust established at this occasion widely contributed in facilitating the negotiation of the agreement in proton-therapy. However, this particularly complex cooperation, risky on the technological aspect and expensive, gave place to a negotiation that lasted more than a year. This case allows us to illustrate some aspects relative to the links between trust and contract. Trust appears as a precondition for the establishment of the contract, as indicated by Billette (1999). There was at first a minimum level of trust between the two parties, which encouraged them to contract. Previously constructed trust therefore played an important role in the negotiation. It facilitated the progress of the contract. Moreover, the contract itself reinforced trust, the two modes of coordination becoming complementary – and not mutually exclusive with one being able to totally substitute itself for the other:

" We negotiated this contract during more than a year. This contract is extremely simple, short, goes to the main point and does not contain ambiguities. The duration of negotiation was long, we sometimes had tight discussions but always open and frank. Every time, we reached a consensus. With NIPPONTECH, when something is acquired, one does not question it afterwards. It strongly contributes to establish a climate of trust. Since we signed this contract, we placed it in a drawer and have never more opened it. " (MO, TECHMED, 1993)

In such a complex project presenting such enormous stakes, a good contract, negotiated in a climate of trust and consensus, allows to establish solid and clear bases for all. It is a little bit like a marriage contract, a cooperation lives, people and situations can evolve, it is better to have a security, even though we trust each other ". (JO, TECHMED, 1993)

This is where the role of the relational contract appears (Ring and Van de Ven, 1992) as long as the formal legal contract had not been completed (due to the very same nature of the common R&D activity). Consequently, trust had to intervene to mitigate the risks of opportunism and to make cooperation work. Negotiation was sometimes slowed down because of the difficulty of

agreeing on the basic technology of the cyclotron that was to be developed. Here are aspects connected to trust in competence:

" We had imagined a revolutionary concept, which went away from the traditional technology. We discussed it with our partners. I think that they relied on us for the technological aspect but that it went away from their work. Finally, we opted together for a more traditional technology on which we met ourselves more easily, notably in engineering " (JO, TECHMED, 1993)

" TECHMED proposed several options. We insisted on developing a project that leaned on rather classic principles. TECHMED has scientific physicists, but we are more directed towards development " (Sa, NIPPONTECH, 1999)

4.2.2. Project development: 1993-1995

It is during the first stages of the development of the product concept that sources and dynamics of trust can be observed at both individual and group levels, at TECHMED as well as at NIPPONTECH. We shall investigate these aspects simultaneously to show their dynamics and interactions. We will also show how *a priori* perceptions, misunderstandings, incomprehension, arisen from difficulties of communication, can entail tensions. These tensions are sources of a certain mistrust, even of distrust, and how these could be quickly overcome due to dialogue and to the trust existing among the persons in charge of the projects at both partners.

The case also indicates that trust and some distrust can coexist, succeed one another and that there are no single dimensional constructs. Let us underline that this cooperation implies a large number of persons within the two entities: mathematicians, draftsmen, designers and specialists of the central parts of the machines and that these persons had had no preliminary contact with their homologues in the partner company (see **appendices 1 and 2**).

The contract stipulated that the partners would develop the concept of the cyclotron and of the complete system in proton therapy by dividing up the tasks in the development of subsets. The first stages of development (general design and central parts, developed mostly by the mathematicians and the draftsmen designers, helped by the specialists in physics, in close cooperation with LA and JO) were to be achieved essentially by TECHMED. This complex system required a precise integration of interfaces between subsets developed by each partner and precise programming of the stages of the development.

4.3. Trust, distrust and mistrust: a dynamic approach

It is interesting to track the sources of trust and the way *a priori* mistrust (even distrust) evolved towards trust during the very first stages of the project. In the first discussions about the central concept of the system, some dissensions appeared concerning the choice of technology. Certain members of the project team at TECHMED, who had had no preliminary contact in Japan, uttered some fears concerning involuntary transfers of key know-how towards the partner.

This gave place to some distrust, stressed with the attitude received from a colleague in sabbatical stay at TECHMED, towards the Japanese in general - rather than towards the partner.

A posteriori, this distrust is attributed to the existence of stereotypes. JO and Sa quickly identified this source of distrust. A decision was made to keep the colleague separated from any close contact with NIPPONTECH and to appoint a coordinator in charge of relations between the teams. The role of JO and of TECHMED personnel who had already had contact with NIPPONTECH was a positive element in dissipating this climate of distrust:
In the beginning, some were a little suspicious. There was a risk to transfer elements of our know-how, in spite of the fact that the division of the machine in subsets offered us a certain protection " (X, mathematician, TECHMED, 1994)
" The perception that X had of Japanese was not positive. It doubtless influenced us, because we did not know them. It is necessary to recognize afterwards that there are certain stereotypes and that we were doubtless influenced by them " (Y, member of the team project, TECHMED, 1994)
" Our colleague did not understand that to collaborate with NIPPONTECH and with the Japanese generally requires that we go beyond purely technical and business questions. The establishment of trusting relations is reached through the comprehension of values and culture. I explained that to some of our collaborators, and it dissipated many misunderstandings» (JO, TECHMED, 1994).
" When I was named coordinator of this project, one of the first things I did was to get into the Japanese culture. I read books on their management but also on their culture and philosophy. It helped me in my discussions with my colleagues here and in my first contacts with NIPPONTECH " (VE, TECHMED, 1994)

" What is essential at the beginning of this type of cooperation is to create a real climate of dialogue, mutual respect and trust. (...). We appreciated a lot the decision of TECHMED to name a project coordinator. We met him several times and it was a very useful human and professional experience. Now we can avoid quite a lot of misunderstandings " (SHI, NIPPONTECH, 1994)

A second example illustrates the dynamics of trust and distrust and how incomprehension was quickly alleviated within the groups of mathematicians and of draftsmen, at TECHMED as well as at NIPPONTECH. During the first phases of the project, each group worked independently on the development of the various subsets. The essential point therefore concerned interfaces, for which it was necessary to exchange numerous calculations and plans. What with jet lag and the nature of this information, most of the contacts were made by means of fax exchanges. This gave place to misunderstandings that sometimes resulted in a climate of distrust towards the partner:
" When we passed on our first calculations to our Japanese colleagues, they had many questions on our methods, verified everything and asked for numerous explanations. We were a little irritated, thought that they did not rely on us, and were even suspicious. We asked ourselves whether they did not try to extirpate things from us " (X, TECHMED, mathematician, 1994)
" In the beginning, we did not understand why Japanese always asked us to clarify all the details of our plans to develop interfaces. I admit that, in my team, we were sometimes very nervous, even suspicious " (K, TECHMED, draftsman)
" We had different methods, used different software packages for the calculations, for the CAO, DAO, etc. This was the source of problems. Afterwards, we have used the same bases» (X, mathematician, TECHMED, 1994)

We communicated in English: the interpretation of sentences was not always easy. Sentences were sometimes long; then, we asked for additional explanations. We are scientists and engineers and communicate a lot through writing. Our teams did not know each other at the beginning. It led to misunderstandings and even sometimes to real dissatisfaction here and at TECHMED " (Sa, NIPPONTECH, 1999)

Eliminating these sources of conflict and the establishment of an interpersonal and intra-group trust was facilitated by the intervention of the project coordinators and, later on, by the direct contacts colleagues had during working meetings. Dialogue, the recognition of the differences of approach in development, the understanding of cultural differences and the defects in communication seem to be at the heart of the process. As such, interpersonal trust (1) among the leaders JO and Sa, (2) among the project managers and (3) among the members of the two teams in direct contact during meetings, allowed intra-and inter-group trust to develop:

" When there were misunderstandings, I got in touch at TECHMED with MO, JO, VE or BE whom I knew well. We tried to understand the sources of these misunderstandings and to remedy them by an improvement of the communication " (Sa, NIPPONTECH, 1999).

" When I felt that it went badly between our teams and those of our partner, I tried to explain to them the differences of approaches, the working manners of our partner, and that they were in the same situation of incomprehension in our respect " (JO, TECHMED, 1994)

" Later, having discussed with JO and among us, we realized that we had badly interpreted things. We changed our perception and our way of communicating. It helped a lot to create a climate of trust between our teams " (X, mathematician, TECHMED, 1994)

" We finally got to have personal contacts with our colleagues with whom we communicated by fax. It is very important to discuss directly because, even though there are sometimes barriers of language, we put faces on names, tried to understand better, talked and even sometimes became friends (...) In fact, we noticed that they tried to help us and to do things for the best rather than to compete with us. We realized that they worked very openly. This contributed to open ourselves and to the reinforcement of the climate of trust between us» (BE, mathematician, TECHMED, 1994)

In fact, they asked all these questions because they tried not only to understand our ways of working to do correctly their own work but also to make their possible so that we can work on the same bases. We make fast development, they are more systematic, prepare in advance every stage, etc. They have a totally different approach. In fact, it was a dialogue of deaf persons. While by discussing with them, we realized it " (K, draftsman, TECHMED, 1994)

This oscillation between trust and distrust has been studied. (Levinsksky, McAllister and Bies (1998)). They oppose the traditional opinions, which see trust and distrust as two separated and opposite constructs (as there is a potential of coexistence), paying limited attention to the social context and to the dynamics of relations. These relations are often considered as one-dimensional constructs to be maintained in a well-balanced and constant way. (But they have multiple facets, balance and constancy being temporary states). The model developed by the three authors adapts

itself perfectly to our case of cooperation in R&D where risk and vulnerability are high. In fact, the authors quote the example of the cooperation between Boeing and the Japanese to illustrate the possible coexistence, during the life of a cooperation, of high trust with strong distrust, connected to the protection of know-how and to the risk of appropriation by the other part. These elements lead to relations that are inevitably complex. Puthod (1995) explains that attentiveness is at the heart of alliance management to limit the acts of mistrust.

4.4.First orders and prototype development (1995-1997)

The period 1995-1997 was characterized by intensive activity, especially in marketing.
The formal contract stipulated that the prototype would be developed after receiving a first order. Each party would manage marketing and sales in its geographic area. Relationships and trust were « stable ». Harmonious contacts, the willingness to share information and to help the partner to solve problems reinforced trust between teams. The activities at TECHMED were focused on the tender made by the leading University Hospital in the USA. After fierce competition TECHMED received this first order. On the other side, NIPPONTECH was also selected to implement the first system in Japan. The development of the prototype was reached as previously planned; each party developing sub-systems, interacting with the partner, sharing highly detailed information and coordinating teams to develop « interfaces ».

« *Each party developed its own sub systems but in close co-operation with TECHMED. We had meetings in Japan, Europe and the USA. We often discussed with JO and his team the technical problems we faced in the development. Since two or three years, our engineering teams work together and co-operate. We have known our colleagues for a long time now and we have learned to work with them, this led to build and reinforce a « strong » climate of trust." (Sa, NIPPONTECH, 1999)*

4.5. The set up of the system: 1998-1999

The set up of such highly sophisticated systems takes several years because of the technical complexity, the need to obtain the “green light” from the Health Authorities, to meet the needs and expectations of end-users and to assess the therapeutic performances. The activities performed on the field during this period are particularly intensive. Technical adjustments are needed, in particular in peripherals and software. The people involved at this stage are the engineers and specialists in tuning the equipment. Most of them had never met their partner before but they trusted them *a priori* . This was due to the positive opinion about the partner and trust between both R&D team members who had established trustworthy relations. They in turn influenced these engineers and specialists. This illustrates the role played by « third parties » in the development of “a priori” trust. But inter-personal trust arose from direct contacts and interactions in the field.

"*When TECHMED received its first order in the US and we received our first order here in Japan, JO and I had almost exclusively worked on the product concept and on technical issues. Our R&D teams worked and collaborated a lot, this contributed to creating trust between teams.*

During the set up of our systems, direct relations with doctors and end-users are central. Our engineers did not know their colleagues from TECHMED. The good climate of trust established between our R&D teams was very helpful. Even if our engineers worked on their own project, they almost immediately shared information and tried to help each other to solve their problems. (Sa, NIPPONTECH, 1999)

Engineers from both teams collaborate very well, supporting their mutual efforts to develop "users friendly" interfaces. Now the communication is very effective, our engineers like to work with their colleagues at TECHMED and they enjoy working with them. (…) I think that a mutual trust exists. (Ka, NIPPONTECH, 1999)

4.6. Recent developments

In order to complete this exploratory case study we shall point out some contexts that could play a role in the dynamics of trust. These elements are seldom present in the literature on trust and co-operation. They show that the dynamics of co-operation can be influenced by changes in both partner firms. These elements are not covered by the agreement but could have an influence on the dynamics of trust. In this case, the rapid growth of TECHMED and especially its takeover of a European competitor implied a reorganization at TECHMED. The proton-therapy activity was located in a new subsidiary. This necessitated the development of new trustworthy relations between persons involved in this project at NIPPONTECH and TECHMED.

Since 1998, TECHMED has grown dramatically, through internal development but especially through the acquisition of several competitors in the USA and Europe. Today TECHMED is considered as the leader in many highly specialized activities based on accelerators (cyclotrons and other similar equipment and complex systems). One of these acquisitions was a joint venture between NIPPONTECH and an American firm. According to TECHMED's top Management, the high level of trust between TECHMED and NIPPONTECH played an important role in this deal.

But to a certain extent, this extremely rapid growth has unconsciously and unexpectedly modified the interpersonal relations between Sa and his friends at the top management of TECHMED, and as a consequence, has somewhat influenced trust between teams. This shows that, even if trust exists among team members, inter-personal relations, through frequent contacts, play an important role in maintaining trust.

The re-location of the proton-therapy activity at TECHMED somewhat reinforced this problem. NIPPONTECH's personnel involved in the process and the "new team" members at TECHMED never met before and had to make acquaintance.
New orders received by TECHMED in Northern-America stimulated the Marketing team at NIPPONTECH to develop marketing in Asia. A decision was made to appoint a new marketing manager in 1999 (Ka).

" We know NIPPONTECH' proton-therapy group very well, and we have built a very strong and long lasting relationship, based on trust, fair play and open co-operation. (…) It was very helpful when we decided to buy shares owned by NIPPONTECH in the US. (MO, TECHMED, July 1999)

"Today we must solve some important problems. TECHMED has been so aggressive on the markets and has taken over almost every competitor in its fields. We must co-operate with TECHMED in order to profit by this situation and to penetrate the Asian markets. But for the marketing side we must co-operate with new colleagues at TECHMED". (Ka NIPPONTECH, August 1999)
"My friends JO and MO are so busy, they are at the top of a big company now. They are my friends and I've been working with them for more than ten years. (…) .I'm a little bit afraid not to have the opportunity to meet them informally and frequently…" (Sa, NIPPONTECH, August 99)

"We know how to communicate with TECHMED, and we trust them, (…) and our teams have learned to work with their colleagues and also to appreciate and to trust them. Now we must establish relations with other persons, (…) it takes time to build personal relations and trust. We have to maintain this positive climate of trust…this is very important in such a co-operation..."(Sa, NIPPONTECH, 1999)

5. Towards an interpretative framework of the dynamic of trust

Table 1 presents a synthesis of the dynamics of trust in this cooperation. Emphasis is put on the origins of trust, the main actors involved (individuals and groups), the "objects" of trust as well as the contextual variables corresponding to the main stages of the life cycle of the agreement. The selected dimensions presented here constitute our interpretative framework.

Conclusion

This exploratory case study aimed at identifying some dimensions of trust that is a dynamic and complex concept and phenomenon. Our case suggests that a "multilevel" analysis of trust (individual, group) is useful to better understand the evolution of trust in and between organizations.

The case also suggests that it would be necessary, in order to study of the dynamics of trust in partnerships to address "intra-organisational" and "inter-organisational" issues. R&D co-operation is characterized by evolution in process influenced by events, a great variety of contexts and interactions between partners. (Dodson 1993,Doz, 1996, Ring and Van de Ven 1994, Ring 1997)-even if initial conditions such as formal contracts and governance structures impact the processes. We hope that our longitudinal case study contributes to a better understanding of how some of these elements influence the various stages of the process.

This case study also identifies the four main stages in the development of trust in the co-operation between TECHMERD and NIPPONTECH in proton-therapy: origins and construction (1992-1993), stabilization (1994), latent (1995-1997), reinforcement (1998), some trouble (1999) and …new development? (2000).

Trust plays multiple roles. In the case TECHMED-NIPPONTECH trust is (1) *a result* of the relations and interactions between partners and of the effects of reputation (Burt and Knez,

1996), -the characteristics of both partners such as competency, reliability, the will to understand each other and cultural sensitivity, in particular, the personality and world-class scientific reputation of JO. His understanding of the Japanese culture,… (2) *A causal variable* or a factor influencing the outcome and success of the co-operation. (3) *A moderator*, essentially to modulate the co-operation at the organisational level (motivation of teams of mathematicians and designers by JO), and inter-organisational (to reactivate the co-operation between teams after a period of transition.

This case study also shed lights on the evolution of trust from a bilateral point of view. It shows (1) how top managers and project leaders contribute in diffusing trust in their teams (Koenig 1999), acting as "third parties" and catalysts. (2) How trust develops at the "group" level (in and between teams) and (3) how interpersonal relations play a central role in the process.

The limits of this exploratory research are numerous; lack of "external" validity, threat of *a posteriori* perceptions and rationalization about the evolution of the co-operation,

Many complementary studies could be drawn from this exploratory case. In particular we could explore and develop the institutional and cultural dimensions of trust in international partnerships (Doney et al, 1998).Hagen and Choe (1998) argued that institutional and social mechanisms, such as control and threat of social punishments contribute to explain co-operation that seem to be based on trust. Trust would also be related to cultural dimensions like those identified by Hofstede in numerous researches. The study of trust in international co-operation between firms rooted in different cultural contexts would also benefit from research led in the field of anthropology, cultural history and Ethical philosophy.

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APPENDIX 1

MAIN STAGES IN THE COOPERATION

Steps	1989 Preliminary Contacts	1991-92 Negotiation of the cooperation in Proton therapy	1992- 94 Development of concept, design Marketing	1995-97 Marketing efforts Orders. Development, Prototype and set-up	1997-1999 Tests and first treatments in Japan Marketing
Initiator, motives and subject of the relations	NIPPONTECH looks for an ion source for its ion source project TECHMED looks for a financial partner	TECHMED: looks for a commercial and financial partner to develop system of proton therapy NIPPONTECH: Looks for technical partner to develop proton therapy system	-Choice of the central concept of cyclotron - Exchange of information on application fields - Development of interfaces between sub-systems developed by each partner	Exchange of information on specifications of systems ordered by US and Japanese clients	NIPPONTECH Request support by TECHMED in instalment of the system in Japan
Main actors (*) **Scientific and technical aspects**	*TECHMED*: JO *NIPPONTECH:* Ta, Sa.	*TECHMED:* JO *NIPPONTECH.* Sa	*TECHMED:* JO, LA, Mathematicians (BE),X, Z Designers, draftsmen, drawers sketchers (MOR), K *NIPPONTECH :* Sa, mathematicians designers	*TECHMED:* DU. +BO specialists in engineering (machines, sub-elements and peripherals) *NIPPONTECH* Sa + same as at TECHMED	*TECHMED:* JO, BE,+ specialists setting up *NIPPONT.* Sa, specialists setting up
Main actors * **Coordinat**	-	*TECHMED* Coordinator MO	*TECHMED* Coordinator MO, LA, VE	TECHMED: MO, VE, DA planning and suppliers	TECHMED : Coordinator Marketing :

ion and management		*NIPPONTECH* : To, Shi	*NIPPONTECH*: Shi		LE *NIPPONT*. Ka

(*) cf. list in appendix 2

APPENDIX 2

MAIN ACTORS AND FUNCTIONS

We have printed TECHMED actors in capital letters and NIPPONTECH actors in small letters.

TECHMED

Scientific and technical aspects :
JO= founder, general director and scientific leader
LA= external specialist, in sabbatical stay at TECHMED in 1992-1993
DU= specialist for technical development
BE= mathematician (responsible of the project proton-therapy)
X= mathematician
K= designer
MOR= designer (responsible of the project)
BO = director: technical department
Z= member of the project team

Managerial aspects:
MO= general director in charge of management
LA= same as above (1992-1993)
VE = project coordinator responsible for relations with NIPPONTECH.
DA= Responsible of planning and assembling the cyclotron
LE= Responsible of marketing proton-therapy

NIPPONTECH

Scientific and technical aspects :
Ta= scientific leader
Sa = engineer concept and development (technical coordination)
To = R&D director

Managerial aspects:
Shi : project coordinator (until 1998 (death))
Ka = responsible for marketing proton-therapy

[1] This classification is certainly arbitrat
[2] This research aimed at analyzing organizational learning processes in R&D five cooperation led by TECHMED from 1990 until 1995.